

## **DIVISION 300   AGGREGATE COURSES**

### Section 301. - AGGREGATE COURSES

*Note: If local conditions indicate that aggregate production will be subcontracted, and that aggregate producers will likely pay Davis-Bacon wage rates, no reduction for labor should be made to the basic rock cost. Also, not all contracts require Davis Bacon rates in basic rock and hauling costs. Check with your Contracting Officer.*

The costs shown herein are applicable only for situations closely fitting the stated assumptions. However, the procedure and work items should be considered and estimated for all projects where that type of work is involved. On larger base and surfacing projects of 25,000 CY or more, consideration should be made for additional economies due to the large quantities. Total in place cost for these large jobs will average about 10% less. On the other hand, for small projects of 5,000 CY or less, costs will be at least 20% higher.

Aggregate costs estimates are broken down by:

- Basic Rock Cost
- Load and Apply
- Haul

#### **Basic Rock Cost**

(Labor: 45 percent)

The following costs assume a production rate of 150 TPH. Material weighs 2,800 to 3,000 lbs/CY loose. Costs shown are in tons and loose cubic yards. Material Grading C, 1-1/2 inch minus.

- **Move-in/move-out** (approximate) Includes cost to set up and take down equipment. Does not include movement of equipment commonly used on other parts of job. Make cost allowance per instructions under Section 151 (Mobilization).

Screened	Crushed Pit Rock	Crushed Quarry Rock
\$4,000	\$9,000	\$15,000

For platform scale add \$2,000 to \$2,500 (includes move-in, set-up, ramps, and certification). If belt scales will be used, make an allowance of \$500-1,500 for certification.

- **Pit development** Estimate pit or quarry development under Section 641, cost may be included in basic rock cost or as a separate pay item.

Costs should include:

- Clearing, grubbing, and slash cleanup
- Access roads
- Conserving topsoil
- Removal of overburden
- Ground control and traffic control
- Restoration
- Seeding

- **Royalty charge** for private pits. These are highly variable, costs range from \$.50/CY to \$1.00/CY or higher.

- **Drilling and shooting**

Method	ID and MT
Normal drilling and shooting: (includes tractor for moving material)	\$1.60/CY loose
	\$1.10/ton
Breaking oversize	\$5.00/CY loose
	\$3.50/ton

- **Ripping** ID and MT  
\$1.17/CY  
\$0.78/ton

- **Crushing** For grading other than *Grading C*, the following multipliers should be applied to crushing costs shown below for pit rock or quarry rock.

Gradation Factor US Customary (English) Units														
Max Size (in)	3"	2"	1-1/2"	1"	3/4"	3"	2"	1-1/2"	1"	3/4"	6"	4"	3"	2"
Grading	A	B	C	D	E	F	G	H	J	K	L	M	N	O
Multiplier	0.9	0.95	1.00	1.10	1.25	0.80	0.9	0.95	1.05	1.20	0.6	0.7	0.7	0.7

**Crushed pit rock** (drilling and shooting and/or ripping generally not required)

ID and MT

\$4.50/CY loose

\$3.30/ton

or

**Crushed quarry rock** (includes loading into crusher)

\$5.35/CY loose

\$3.85/ton

*Note: If size-ratio requirements are included in the grading, increase crushing costs approximately 10%.*

**Bentonite Binder:** If bentonite binder is specified at 2% of aggregate quality, add \$2.00 per ton (\$2.20 per metric ton) to rock cost for projects over 10,000 tons (9,070 metric tons) and \$3.00 per ton (\$3.31 per metric ton) for smaller projects.

- **Screening only** ID and MT  
\$2.70/CY loose  
\$2.05/ton
- **Pit run** (no crushing - includes dozer, loader, and operators) ID and MT  
\$2.10/CY loose  
\$1.45/ton
- **Stockpiling** (use only where required by contract or job conditions) ID and MT  
\$0.90/CY loose  
\$0.65/ton
- **Weighting:** (Platform Scales) ID and MT  
\$0.27/ton
- **Contractor Quality Control:** (If required by contract, add the cost of contractor sampling and testing. See Section 153.)

**Production Losses**

In computing aggregate costs, one should calculate the total cost of producing the final quantity of aggregate desired. To determine unit costs, the total costs of each major subdivision (basic rock cost, load and apply, and haul) should then be divided by the final desired quantity. By following this procedure, the cost of normal production losses can be included in the unit cost of the final quantity.

The following production losses should be considered:

- **Ongrade process and haul losses:** essentially negligible for conscientious operator.
- **Stockpiling losses:** Approximately 5 percent; use only if stockpiling required by contract, physical arrangement of pit, or work schedule imposed by contract.
- **Crushing/screening/blasting.**
  - Quarry operation approximately 5-10 percent.
  - Gravel or rock pit - 20-30 percent

These seemingly high losses result from a high percentage of fines found in such pits. Technically, it is not "lost" material, but "reject" necessitated by gradation requirements. Actual estimate of losses should be based on field tests or experience.

**Small Quantities**

Increase costs for small projects as calculated above by about 20% for jobs where the quantities are less than 5,000 tons or 3,500 CY.

**Example Basic Rock Calculation**

Grading D, compact by hauling equipment.

Quantity required on the road - 10,000 tons

Location: Idaho (Area 2, Zone 2)

Assume hard rock quarry with stockpiling and weighing required.

Stockpiling loss - 5 percent

Crushing loss - 10 percent

To obtain 10,000 tons for the road, the contractor will have to drill, shoot, and process approximately 11,500 tons ( $10,000 + 15\% = 11,500$  tons).

Contractor will stockpile  $10,000 \text{ tons} + 5\% = 10,500$  tons.

Move in-out (includes platform scale) \$17,000 - Include under Section 151 - Mobilization.

Drill and shoot $\$1.10 \times 11,500$	\$12,650.00
Crushing and screening $\$3.80 \times 11,500 \times 1.1$	\$48,070.00
Stockpiling $\$0.65 \times 10,500$	\$ 6,825.00
Weighing $\$0.27 \times 10,000$	\$ 2,700.00
Contractor sampling & testing (lump sum)	<u>\$ 3,000.00</u>
Total Cost	\$73,245.00

Unit basic rock cost =  $\frac{\$73,245.00}{10,000 \text{ tons}} = \$7.32/\text{ton}$

Adjust for Idaho Area 2, Zone 2, 45% labor;  $\$7.32 \times 1.01 = \$7.39/\text{ton}$

## Load and Apply

(Labor = 40 percent)

- **Loading** costs are variable depending on procedures at pit. These vary depending on loading method.

Loading Method	ID and MT
from belt (included in basic rock cost)	\$0
from hopper (included in basic rock cost)	\$0
pit run (included in basic rock cost)	\$0
from stockpile	\$0.98/CY loose
	\$0.72/ton

- |   |   |   |
|---|---|---|
| ▪ <b>Initial Spreading</b> (knocking down piles and rough grading if needed)  |   | <b>ID and MT</b><br>\$0.56/CY loose<br>\$0.40/ton |
| ▪ <b>Grid rolling</b> (approximate)   | <b>ID and MT</b><br>\$0.66/CY loose<br>\$0.52/ton |   |
| ▪ <b>Grading of Aggregate base or surface course</b> (approximate)  |   | <b>ID and MT</b><br>\$0.80/CY loose<br>\$0.56/ton |
| ▪ <b>Compaction</b> (approximate)   | <b>ID and MT</b>                                  |   |
| With hauling equipment  | \$0   |   |
| With rollers  | \$0.59/CY loose<br>\$0.46/ton                     |   |
| ▪ <b>Watering:</b> Estimate under Section 160; water should be incidental to Section 301, unless Forest has sufficient contract administration personnel for inspection of watering as separate pay item. |   |   |

## Aggregate Haul

(Labor = 30-50 percent)

Estimate haul under Section 204. These costs are based on loose cubic yards. Use appropriate weight conversion factor to convert to \$/ton-mi. If measurement for payment or credit is on another basis, appropriate adjustment factors must be made.

If Construction Induced Maintenance is needed, it should be included in aggregate haul costs.

### Example Aggregate Haul Calculation

**Given:** Variable costs of haul (based on road characteristics) and average round trip travel speed

3.0 miles @ 30 mph

Belly dump trucks (20 CY)

6.0 miles @ 15 mph

Density: 1.4 tons per cubic yard

2.5 miles @ 10 mph (include distance to turnaround)

Basis of payment: ton

Location: Idaho - Area 1 (Zone 2)

$$\text{Haul Cost} = \text{Fixed cost} + (\text{variable haul cost} \times \text{haul distances})$$

$$\text{Haul Cost} = 0.65 + (\$0.45 * 3.0) + (\$0.94 * 6.0) + (\$1.39 * 2.5) = \$11.12/\text{ton}$$

Adjust for Idaho Area 1 (Zone 2) (35% Labor): \$12.02 x 1.00 = \$11.12/ton

**Section 303. - ROAD RECONDITIONING**

(Labor 40-60 percent)

Normally, the majority of "reconditioning" work should be done with a grader with some minor blasting and/or tractor work for localized rock problems. More extensive work should be covered in the appropriate sections.

Good field classification and design will usually avoid the problem of calling for use of this specification when more appropriate work items may be needed. Other examples can be traced to situations where, through years of maintenance a roadway has been widened and shifted slightly away from the original alignment. Trees that used to be outside the shoulder by 5-10 feet, were eventually cut down for safety reasons, but the *stumps remain* in what now is the shoulder.

Estimator should also watch out for *subgrade boulders* which were originally well covered by native subgrade material, but the covering is now thin or absent.

- **Removing Slides** - Use time and equipment costs. (Estimate all slides in excess of 10 cubic yards per station under Section 204).
- **Pull ditches** with grader and clean catch basins      **ID and MT**  
\$350/Mile
- **Scarifying and shaping** (for ID and MT - \$/mile)

	Single Lane	Double Lane
Average	\$1,040	\$1,370
Heavy	\$1,600	\$2,150

- **Finish grading with blade**      **ID and MT**  
Single Lane      \$390/Mile  
Double Lane      \$525/Mile

- **Compaction** (for ID and MT - \$/mile)

Method	Single Lane	Double Lane
B	\$270	\$350
C	\$405	\$625
D	-0-	-0-
E	\$270	\$350

- **Water** - Estimate under Section 160 or include in Section 303 as incidental.
- **Constructing New Ditch** - Include under Section 204.
- **Erosion Control Measures** - Include under Section 157.
- **Clearing and Grubbing** - Include under Section 201.
- **Asphalt and Aggregate Surfaces** - Estimated using Sections 204, 301, 404, 414, and 430.
- **Contractor Quality Control** - Where applicable, make a subsidiary allowance to this pay item for contractor quality control.

**Section 306. - DUST PALLATIVE**

(Contract Item)

Refer to current dust palliative manufacturer and geotechnical engineering information for detailed information on product characteristics, application rates, estimating procedure, conversion factors and calculations. If product is unavailable locally, recommendations and information are available from the RO Materials Engineering. The following is a summary of essential information.

- **Application Rates.** See Application Rate Tables in Standard Specification for Construction of Roads and Bridges on Federal Highway Projects, FP-03. Rates for lignin sulfonate and chloride products are based on the solid contents shown below, "*Approximate Weight-Volume Factors @ °F*". These products may be furnished with varying amounts of water and if so, adjustments based upon the weight of solids may be necessary on the application rates and payment. Rates will vary depending on the type and condition of the surface and the amount of residual dust abatement material present. For example, more dust abatement material will be required for loose pit-run gravel and less for unsurfaced roads in clay material. Due to leaching of the chloride products, it is recommended that the product be applied *slightly narrower in width* than the surfacing, particularly along *riparian areas*.

**Approximate Weight-Volume Factors @ 60°F**

<b>Material</b>	<b>Gallons/Ton</b>	<b>Pounds/Gallon</b>
Lignin Sulfonate (50 percent solids, 1.26 S.G.)	190	10.51
Magnesium Chloride (32 percent solids, 1.317 S.G.)	182	10.98
Calcium Chloride (38 percent solids)	171	11.69

- **Unit Material Cost.** Prices can be extremely variable, particularly for dust oils. Up-to-date quotes should be obtained from local suppliers for each project.
- **Shipping Costs:** Shipping costs are variable and should be verified for each project.
- **Road Preparation:** Road preparation costs will depend on the existing surface condition, requirements in other Sections such as 301 or 303, and the method specified. See Section 303 for grading costs and Section 160 for watering.
- **Application Cost:** Typical application costs are \$25 to \$85 per M-Gals (\$5 to \$15 per ton) of liquid, depending on the type of distributor.

**Section 321. - ROAD SURFACE STABILIZATION**

(Contract Item)

See R1 Forest Service Supplement for roadbed preparation and material application rate. Estimate road preparation costs using time and equipment and materials application costs from supplier.

*End of Division 300   Aggregate Courses*